PATENT ABSTRACTS OF JAPAN

(11)Publication number : **10-019600**
(43)Date of publication of application : **23.01.1998**

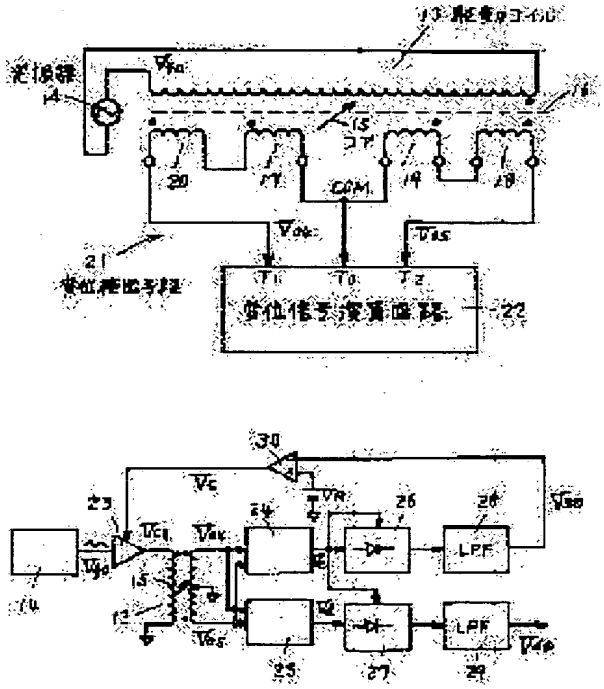
(51)Int.Cl. **G01D 5/22**
G01B 7/00

(21)Application number : **08-173122**
(22)Date of filing : **03.07.1996**

(71)Applicant : **YOKOGAWA ELECTRIC CORP**
(72)Inventor : **TOYODA SHOJIRO**

(54) SHIFT-CONVERTING APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To improve measurement accuracy and stability by deriving a pair of differential signals generated differentially in a conductor pattern formed at an insulating substrate to correspond to the shift of a core, and operating a substantial ratio with the use of sum and difference of a pair of the differential signals.
SOLUTION: A magnetic flux impressed by a transmitter 14 and generated at a driving coil 13 is applied to coils 17, 18 and 19, 20 as a conductor pattern. A series circuit of the coil 17, 20 is connected to show an opposite polarity to a series circuit of the coils 18, 19. A connecting point between the coils 17 and 19 is induced as a common potential point COM. Differential signals V04, V05 are output from one ends of the coils 20, 18 to a sum operation circuit 24 and a difference operation circuit 25. A sum signal Vs and a difference signal Vd of the differential signals are operated at the sum operation circuit 24 and difference operation circuit 25, output to a ratio operation circuit, where a ratio of the signal is obtained. An output signal corresponding to a shift is obtained at an output terminal.



LEGAL STATUS
[Date of request for examination] 13.03.1997

[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3024554
[Date of registration]	21.01.2000
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] A displacement detection means to derive the differential signal of the pair generated in differential at these conductor patterns corresponding to the variation rate of said core to the coiled form magnetic flux which the conductor pattern of a pair is formed at least and drawn by the core to an insulating substrate, The displacement inverter characterized by calculating substantially the ratio of a sum operation means to calculate the sum of said differential signal and to output a sum signal, a difference operation means to calculate the difference of said differential signal and to output a difference signal, and said sum signal and said difference signal, and providing the displacement operation means corresponding to said variation rate.
[Claim 2] The displacement inverter according to claim 1 characterized by calculating said ratio by controlling the energizing voltage impressed to said magnetic flux so that said sum signal becomes fixed.
[Claim 3] The displacement inverter according to claim 1 characterized by calculating said sum signal and said difference signal algebraically, and asking for said ratio.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the displacement inverter which detects a variation rate using change of a mutual inductance, and relates to the displacement inverter which improved the property so that it might especially be hard to be influenced of change by environmental.
[0002]
[Description of the Prior Art] Drawing 6 is the block diagram showing the configuration of the 1st conventional displacement inverter. this configuration -- JP,62-3684,Y -- "-- name [of a design]: -- a variation rate -- although indicated by inverter", that profile is explained below.
[0003] Here, for 1, as for a coil and 4, an insulating substrate, and 2 and 3 are [a core and 5] shafts. It is prepared in one field of an insulating substrate 1 so that the electric conduction pattern which forms a coil 2 may become about 3 corniform along with a circumferencial direction.
[0004] Moreover, the central part of this insulating substrate 1 is pierced circularly, and the annular bobbin around which the coil 3 was wound is fitted in this punching section. Either is used as an exiting coil, another side is used as a sensing coil, and a coil 2 is used as a sensing coil, for example, as for these coils 2 and 3, a coil 3 is used as an exiting coil.
[0005] As for a core 4, a cross-section configuration is formed in the typeface of KO by high permeability material, such as a ferrite. As this core 4 sandwiches a coil 2 and a coil 3 between that parallel side, that connection side is arranged at the punching section of an insulating substrate 1.
[0006] A shaft 5 rotates on the turning effort which should carry out displacement conversion, and is inserted in the punching section of an insulating substrate 1 pivotable. The connection side of a core 4 is attached in this shaft 5, and a core 4 will be rotated on it according to rotation of a shaft 5.
[0007] In such a configuration, magnetic coupling of the coils 2 and 3 is indirectly carried out through the core 4. Therefore, when ac energisation of the coil 3 shall be carried out, from a coil 2, the output voltage corresponding to linkage area with a core 4 will be sent out.
[0008] Here, since the coil 2 is formed in the shape of about 3 square shapes so that decussation area with a core 4 may change along the hand of cut of a shaft 5, i.e., the migration direction of a core 4, it can obtain the output voltage corresponding to the rotation displacement angle theta of a shaft 5.
[0009] However, when the center position of the insulating substrate 1 which is a fixed object, and the center position of the shaft 5 which is a movable object shift according to such a configuration, an error will be produced to the predetermined transfer characteristic. Therefore, if it is in processing of this etc., and assembly, an advanced technique is required and a considerable man day is needed.

[0010] Then, what improved this point is shown in drawing 7 . Drawing 7 (A) shows the electric conduction pattern with which drawing 7 (B) was formed in the field of another side of an insulating substrate in the electric conduction pattern formed in one field of an insulating substrate, respectively.
[0011] These electric conduction patterns 6 and 7 are formed in the front flesh side of the insulating substrate 8 corresponding to the insulating substrate 1 in drawing 6 as a configuration corresponding to a coil 2, and they are formed as a symmetrical pattern to line Y-Y' of the diameter direction so that area may change in differential along the hand of cut of the core 4 of drawing 6 .
[0012] furthermore -- while differential connection of these electric conduction patterns 6 and 7 is made as it indicates drawing 8 that a differential output is obtained, and taking into consideration the magnetic-flux distribution by the configuration of a core 4 -- the variation rate of a core 4 -- it is formed so that a differential output may change according to a predetermined function property (a straight line -- or nonlinear) according to an amount.
[0013] Drawing 9 is the property Fig. having shown one example of the output characteristics of the electric conduction pattern shown in drawing 7 , and the displacement angle theta of a core 4 is shown on the axis of abscissa by output voltage e1 at the axis of ordinate. In drawing 9 , the two-dot chain line shows the differential output of a continuous line a and a broken line b for the output according [a broken line b] the output according [a continuous line a] to the electric conduction pattern 6 to the electric conduction pattern 7.
[0014] Since two electric conduction patterns 6 and 7 are formed so that it may change in [area] differential along the migration direction of a core 4, and these electric conduction patterns 6 and 7 are connected so that a differential output may be obtained even if the center position of an insulating substrate 8 and the center position of a shaft 5 shift if such an electric conduction pattern is used, an error is not produced to the predetermined transfer characteristic.
[0015] Furthermore, the conversion configuration which acquires the displacement signal of a direct current using the coil formed by such electric conduction patterns 6 and 7 is shown in drawing 10 . Since energizing voltage Vf is impressed to the coil 3 from the oscillator 10, corresponding to the variation rate of a core 4, output signals V01 and V02 are outputted to the electric conduction patterns 6 and 7.
[0016] Furthermore, the energizing voltage Vf in this case is about Vm considering the amplitude of energizing voltage Vf, and omega as angular frequency of energizing voltage Vf. Vf=Vm-SINomegat (1)
It is come out and shown.
[0017] moreover, the displacement angle when making into zero a mutual inductance in case a displacement angle is zero about M0, and the point that V01 and V02 become symmetrical about theta and phi -- the phase gap with an excitation signal and a detecting signal -- then -- V01=M0-(1+theta) -Vm-SIN (omega t+phi) (2)
It is come out and shown.
[0018] To this appearance V02=M0 -(1-theta)- Vm-SIN (omega t+phi) (3)
******
[0019] Moreover, output signal V03 V03=V01-V02=2, theta-M 0, and Vm-SIN (omega t+phi) (4)
It becomes.
[0020] Synchronous detection is made by making energizing voltage Vf into a reference sign in the synchronous detection circuit 11, and this output signal V03 is further filtered through a low pass filter 12, and is acquired by the outgoing end as output voltage V04 of a direct current.
[0021]
[Problem(s) to be Solved by the Invention] However, as shown also in the above

formulas (3), this output signal V04 is acquired as a form proportional to the displacement angle theta, but since it is proportional also to the mutual inductance M0 in case the amplitude Vm and displacement angle of energizing voltage Vf are zero besides the displacement angle theta, there is a fault to which an output signal V03 also becomes it unstable that these are unstable.
[0022] Furthermore, since energizing voltage Vf is used as a reference sign in the case of carrying out synchronous detection shown in drawing 10 , if a phase shift is between energizing voltage Vf and an output signal V03, in the synchronous detection circuit 11, it will become an error. In the conventional circuitry shown in drawing 7 and drawing 10 according to these situations, highly-precise-izing and high stabilization is difficult.
[0023]
[Means for Solving the Problem] This invention as main configurations for solving the above technical problem A displacement detection means to derive the differential signal of the pair generated in differential at these conductor patterns corresponding to the variation rate of a previous core to the coiled form magnetic flux which the conductor pattern of a pair is formed at least and drawn by the core to an insulating substrate, The ratio of a sum operation means to calculate the sum of a previous differential signal and to output a sum signal, a difference operation means to calculate the difference of a previous differential signal and to output a difference signal, and a previous sum signal and a previous difference signal is calculated substantially, and the displacement operation means corresponding to a previous variation rate is provided.
[0024]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using drawing. Drawing 1 is the block diagram showing the gestalt of 1 operation of this invention. 13 is a drive coil and this drive coil 13 corresponds to the coil 3 of drawing 6 .
[0025] The magnetic flux which alternating voltage Vf0 was impressed with the oscillator 14, and was generated in the drive coil 13 is impressed to the coils 17 and 18 formed in the Ath page which is one fields of the insulating substrate 16 which was formed as an electric conduction pattern, and which is mentioned later, and the coils 19 and 20 formed in the Bth page which is fields of another side through the core 15 corresponding to the core 4 of drawing 6 .
[0026] The coil 20 is arranged on the table reverse side, respectively, it connects with a serial by like-pole nature, and coils 18 and 19 are connected to the Bth page side to which a coil 19 counters the Bth page side which counters for receiving the coil 17 of the Ath page receiving the coil 18 of the Ath page for coils 17 and 20 by like-pole nature at the serial, respectively.
[0027] And each coils 17-20 are arranged so that it may become the configuration of the coil of a multilayer volume distributed over trapezoidal shape so that radii may be drawn to the central point of an insulating substrate 16, respectively.
[0028] Moreover, the series circuit of coils 17 and 20 is connected with the series circuit and reversed polarity of coils 18 and 19, the node with coils 17 and 19 is drawn as a common potential point COM, and differential signals V04 and V05 are drawn from the end of a coil 20, and the end of a coil 18, respectively.
[0029] The displacement detection means 21 is constituted from these oscillators 14, an insulating substrate 16, a drive coil 13, coils 17-20, a core 15, etc., and differential signals V04 and V05 are impressed to each input edges T1 and T2 of the displacement signal arithmetic circuit 22 to the common edge T0.
[0030] Next, the configuration of coils 17-20 is explained using the electric conduction pattern shown in drawing 2 . Coils 19 and 20 are formed, respectively with the electric conduction pattern by which, as for drawing 2 (B), coils 17 and 18 were formed in the Bth page side of an insulating substrate 16 with the electric

conduction pattern with which drawing 2 (A) was formed in the Ath page side of the disc-like insulating substrate 16.
[0031] If 180 degrees also of relation with the coils 19 and 20 of the Bth page are also rotated to the central point of an insulating substrate 16, the relation with the coils 17 and 18 of the Ath page is formed, respectively so that it may become the same configuration, so that it may become the same configuration, if 180 degrees rotates to the central point of an insulating substrate 16.
[0032] Next, the internal configuration of the displacement signal arithmetic circuit 22 is concretely explained using drawing 3 in a form including the displacement detection means 21. From an oscillator 14, alternating voltage Vf0 is impressed to the control amplifier 23 with which the gain is adjusted with a control signal VC, the amplitude is controlled here and a driving signal Vf1 is impressed to a drive coil 13 from the outgoing end.
[0033] The differential signal V04 generated in a series circuit with coils 17 and 20 according to the variation rate of a core 15 and the differential signal V05 generated in a series circuit with coils 18 and 19 are outputted to the sum arithmetic circuit 24 and the difference arithmetic circuit 25, respectively.
[0034] In the sum arithmetic circuit 24, the sum with differential signals V04 and V05 calculates as a sum signal VS, and a difference with differential signals V04 and V05 calculates as follows as a difference signal Vd in the difference arithmetic circuit 25, respectively.
VS=V04+V05=2, M0, Vf1 (5)
Vd=V04-V05=2, M0, Vf1, and theta (6)
[0035] Synchronous detection is made by the synchronous detection circuits 26 and 27, respectively, using the sum signal VS as reference voltage, and the sum signal VS and the difference signals Vd, such as this, are outputted to low pass filters 28 and 29, respectively.
[0036] It is outputted to a comparator 30 and the gain of a control amplifier 23 is controlled by the control signal VC which is compared with a programmed voltage VR here and appears in the output, and the output signal VSD of a low pass filter 28 is controlled so that an output signal VSD finally becomes equal to a programmed voltage VR.
[0037] Making the output signal VSD equal to a programmed voltage VR will control M0 and Vf1 uniformly. If the output signal VdD of the low pass filter 29 corresponding to the difference signal Vd makes K1 the constant determined from an excitation wave VdD=K1, M0, Vf1, andtheta (7)
It becomes.
[0038] Here, since M0 and Vf1 are controlled to become fixed, (7) types make K2 a constant. VdD=K2andtheta (8)
A next door and an output signal VdD will be proportional to the displacement angle theta, and the effect of a driving signal Vf1 etc. will not receive them.
[0039] Although drawing 4 is the property Fig. showing relation with the output signal VdD over the displacement angle theta, the differential signals V04 and V05 shown here are as follows.
V04=M0(1+theta) Vf1 (9)
V05=M0(1-theta) Vf1 (10)
[0040] Drawing 5 shows the configuration of other displacement signal arithmetic circuits which changed the configuration of the displacement signal arithmetic circuit shown in drawing 3 . Although considered as the configuration which controls a sum signal uniformly and outputs a difference signal in the circuit shown in drawing 3 , it is made to do the division of a sum signal and a difference signal with the configuration shown in drawing 5 .
[0041] From the oscillator 14, alternating voltage Vf0 is outputted and the driving signal Vf2 is impressed to the drive coil 13 through amplifier 31. the differential

signal V05 generated to the both ends of the series circuit of differential signal V04' generated to the both ends of a series circuit with coils 17 and 20, and coils 18 and 19 -- ' -- respectively -- in the sum arithmetic circuit 24, the sum of differential signal V04' and V05' is outputted as sum signal VS', and the difference of differential signal V04' and V05' is outputted as difference signal Vd' in the difference arithmetic circuit 25, respectively.

[0042] It is outputted to the ratio arithmetic circuit 32, ratio Vd'/VS', such as this, calculates here, VS and Vd are replaced with a formula (5) to the outgoing end from (6) as output signal VdD' at VS' and Vd', and these sum signal VS' and difference signal Vd' are VdD'=theta. (11)

****

[0043] Thus, output signal VdD' becomes the function of the displacement angle theta, detects this synchronously by making sum signal VS' into a reference sign in the synchronous detection circuit 33, and can acquire the output signal corresponding to the variation rate of the direct current to the outgoing end through a low pass filter 34.

[0044]

[Effect of the Invention] As mentioned above, according to invention indicated to have explained concretely with the gestalt of implementation of invention by each claim Since it constituted so that the differential signal of the pair generated in differential might be drawn to the conductor pattern formed in the insulating substrate corresponding to the variation rate of a core and these substantial ratios might be calculated using the sum and the difference of a differential signal of these pairs producing the error by the phase shift of the amplitude of the magnetic flux impressed to a conductor pattern, or a driving signal, i.e., magnetic flux and a differential signal, etc. -- there is nothing -- high degree of accuracy and quantity -- a stable variation rate -- an inverter is realizable.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the displacement inverter which detects a variation rate using change of a mutual inductance, and relates to the displacement inverter which improved the property so that it might especially be hard to be influenced of change by environmental.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] Drawing 6 is the block diagram showing the configuration of the 1st conventional displacement inverter. this configuration -- JP,62-3684,Y -- "-- name [of a design]: -- a variation rate -- although indicated by inverter", that profile is explained below.
[0003] Here, for 1, as for a coil and 4, an insulating substrate, and 2 and 3 are [a core and 5] shafts. It is prepared in one field of an insulating substrate 1 so that the electric conduction pattern which forms a coil 2 may become about 3 corniform along with a circumferencial direction.
[0004] Moreover, the central part of this insulating substrate 1 is pierced circularly, and the annular bobbin around which the coil 3 was wound is fitted in this punching section. Either is used as an exiting coil, another side is used as a sensing coil, and a coil 2 is used as a sensing coil, for example, as for these coils 2 and 3, a coil 3 is used as an exiting coil.
[0005] As for a core 4, a cross-section configuration is formed in the typeface of KO by high permeability material, such as a ferrite. As this core 4 sandwiches a coil 2 and a coil 3 between that parallel side, that connection side is arranged at the punching section of an insulating substrate 1.
[0006] A shaft 5 rotates on the turning effort which should carry out displacement conversion, and is inserted in the punching section of an insulating substrate 1 pivotable. The connection side of a core 4 is attached in this shaft 5, and a core 4 will be rotated on it according to rotation of a shaft 5.
[0007] In such a configuration, magnetic coupling of the coils 2 and 3 is indirectly carried out through the core 4. Therefore, when ac energisation of the coil 3 shall be carried out, from a coil 2, the output voltage corresponding to linkage area with a core 4 will be sent out.
[0008] Here, since the coil 2 is formed in the shape of about 3 square shapes so that decussation area with a core 4 may change along the hand of cut of a shaft 5, i.e., the migration direction of a core 4, it can obtain the output voltage corresponding to the rotation displacement angle theta of a shaft 5.
[0009] However, when the center position of the insulating substrate 1 which is a fixed object, and the center position of the shaft 5 which is a movable object shift according to such a configuration, an error will be produced to the predetermined transfer characteristic. Therefore, if it is in processing of this etc., and assembly, an advanced technique is required and a considerable man day is needed.
[0010] Then, what improved this point is shown in drawing 7 . Drawing 7 (A) shows the electric conduction pattern with which drawing 7 (B) was formed in the field of another side of an insulating substrate in the electric conduction pattern formed in one field of an insulating substrate, respectively.
[0011] These electric conduction patterns 6 and 7 are formed in the front flesh side of the insulating substrate 8 corresponding to the insulating substrate 1 in drawing 6 as a configuration corresponding to a coil 2, and they are formed as a

symmetrical pattern to line Y-Y' of the diameter direction so that area may change in differential along the hand of cut of the core 4 of drawing 6 .
[0012] furthermore -- while differential connection of these electric conduction patterns 6 and 7 is made as it indicates drawing 8 that a differential output is obtained, and taking into consideration the magnetic-flux distribution by the configuration of a core 4 -- the variation rate of a core 4 -- it is formed so that a differential output may change according to a predetermined function property (a straight line -- or nonlinear) according to an amount.
[0013] Drawing 9 is the property Fig. having shown one example of the output characteristics of the electric conduction pattern shown in drawing 7 , and the displacement angle theta of a core 4 is shown on the axis of abscissa by output voltage e1 at the axis of ordinate. In drawing 9 , the two-dot chain line shows the differential output of a continuous line a and a broken line b for the output according [a broken line b] the output according [a continuous line a] to the electric conduction pattern 6 to the electric conduction pattern 7.
[0014] Since two electric conduction patterns 6 and 7 are formed so that it may change in [area] differential along the migration direction of a core 4, and these electric conduction patterns 6 and 7 are connected so that a differential output may be obtained even if the center position of an insulating substrate 8 and the center position of a shaft 5 shift if such an electric conduction pattern is used, an error is not produced to the predetermined transfer characteristic.
[0015] Furthermore, the conversion configuration which acquires the displacement signal of a direct current using the coil formed by such electric conduction patterns 6 and 7 is shown in drawing 10 . Since energizing voltage Vf is impressed to the coil 3 from the oscillator 10, corresponding to the variation rate of a core 4, output signals V01 and V02 are outputted to the electric conduction patterns 6 and 7.
[0016] Furthermore, the energizing voltage Vf in this case is about Vm considering the amplitude of energizing voltage Vf, and omega as angular frequency of energizing voltage Vf. Vf=Vm-SINomegat (1)
It is come out and shown.
[0017] moreover, the displacement angle when making into zero a mutual inductance in case a displacement angle is zero about M0, and the point that V01 and V02 become symmetrical about theta and phi -- the phase gap with an excitation signal and a detecting signal -- then -- V01=M0-(1+theta) -Vm-SIN (omega t+phi) (2)
It is come out and shown.
[0018] To this appearance V02=M0 -(1-theta)- Vm-SIN (omega t+phi) (3)
******.
[0019] Moreover, output signal V03 V03=V01-V02=2, theta-M 0, and Vm-SIN (omega t+phi) (4)
It becomes.
[0020] Synchronous detection is made by making energizing voltage Vf into a reference sign in the synchronous detection circuit 11, and this output signal V03 is further filtered through a low pass filter 12, and is acquired by the outgoing end as output voltage V04 of a direct current.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to invention indicated to have explained concretely with the gestalt of implementation of invention by each claim, the differential signal of the pair generated in differential in the conductor pattern formed in the insulating substrate is corresponded to the variation rate of a core. producing the error by the phase shift of the amplitude of the magnetic flux impressed to a conductor pattern, or a driving signal, i.e., magnetic flux and a differential signal, etc., since it constituted so that it might derive and these substantial ratios might be calculated using the sum and the difference of a differential signal of these pairs -- there is nothing -- high degree of accuracy and quantity -- a stable variation rate -- an inverter is realizable.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, as shown also in the above formulas (3), this output signal V04 is acquired as a form proportional to the displacement angle theta, but since it is proportional also to the mutual inductance M0 in case the amplitude Vm and displacement angle of energizing voltage Vf are zero besides the displacement angle theta, there is a fault to which an output signal V03 also becomes it unstable that these are unstable.
[0022] Furthermore, since energizing voltage Vf is used as a reference sign in the case of carrying out synchronous detection shown in drawing 10 , if a phase shift is between energizing voltage Vf and an output signal V03, in the synchronous detection circuit 11, it will become an error. In the conventional circuitry shown in drawing 7 and drawing 10 according to these situations, highly-precise-izing and high stabilization is difficult.

[Translation done.]

MEANS

[Means for Solving the Problem] This invention as main configurations for solving the above technical problem A displacement detection means to derive the differential signal of the pair generated in differential at these conductor patterns corresponding to the variation rate of a previous core to the coiled form magnetic flux which the conductor pattern of a pair is formed at least and drawn by the core to an insulating substrate, The ratio of a sum operation means to calculate the sum of a previous differential signal and to output a sum signal, a difference operation means to calculate the difference of a previous differential signal and to output a difference signal, and a previous sum signal and a previous difference signal is calculated substantially, and the displacement operation means corresponding to a previous variation rate is provided.
[0024]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using drawing. Drawing 1 is the block diagram showing the gestalt of 1 operation of this invention. 13 is a drive coil and this drive coil 13 corresponds to the coil 3 of drawing 6 .
[0025] The magnetic flux which alternating voltage Vf0 was impressed with the oscillator 14, and was generated in the drive coil 13 is impressed to the coils 17 and 18 formed in the Ath page which is one fields of the insulating substrate 16 which was formed as an electric conduction pattern, and which is mentioned later, and the coils 19 and 20 formed in the Bth page which is fields of another side through the core 15 corresponding to the core 4 of drawing 6 .
[0026] The coil 20 is arranged on the table reverse side, respectively, it connects with a serial by like-pole nature, and coils 18 and 19 are connected to the Bth page side to which a coil 19 counters the Bth page side which counters for receiving the coil 17 of the Ath page receiving the coil 18 of the Ath page for coils 17 and 20 by like-pole nature at the serial, respectively.
[0027] And each coils 17-20 are arranged so that it may become the configuration of the coil of a multilayer volume distributed over trapezoidal shape so that radii may be drawn to the central point of an insulating substrate 16, respectively.
[0028] Moreover, the series circuit of coils 17 and 20 is connected with the series circuit and reversed polarity of coils 18 and 19, the node with coils 17 and 19 is drawn as a common potential point COM, and differential signals V04 and V05 are drawn from the end of a coil 20, and the end of a coil 18, respectively.
[0029] The displacement detection means 21 is constituted from these oscillators 14, an insulating substrate 16, a drive coil 13, coils 17-20, a core 15, etc., and differential signals V04 and V05 are impressed to each input edges T1 and T2 of the displacement signal arithmetic circuit 22 to the common edge T0.
[0030] Next, the configuration of coils 17-20 is explained using the electric conduction pattern shown in drawing 2 . Coils 19 and 20 are formed, respectively with the electric conduction pattern by which, as for drawing 2 (B), coils 17 and 18

were formed in the Bth page side of an insulating substrate 16 with the electric conduction pattern with which drawing 2 (A) was formed in the Ath page side of the disc-like insulating substrate 16.
[0031] If 180 degrees also of relation with the coils 19 and 20 of the Bth page are also rotated to the central point of an insulating substrate 16, the relation with the coils 17 and 18 of the Ath page is formed, respectively so that it may become the same configuration, so that it may become the same configuration, if 180 degrees rotates to the central point of an insulating substrate 16.
[0032] Next, the internal configuration of the displacement signal arithmetic circuit 22 is concretely explained using drawing 3 in a form including the displacement detection means 21. From an oscillator 14, alternating voltage Vf0 is impressed to the control amplifier 23 with which the gain is adjusted with a control signal VC, the amplitude is controlled here and a driving signal Vf1 is impressed to a drive coil 13 from the outgoing end.
[0033] The differential signal V04 generated in a series circuit with coils 17 and 20 according to the variation rate of a core 15 and the differential signal V05 generated in a series circuit with coils 18 and 19 are outputted to the sum arithmetic circuit 24 and the difference arithmetic circuit 25, respectively.
[0034] In the sum arithmetic circuit 24, the sum with differential signals V04 and V05 calculates as a sum signal VS, and a difference with differential signals V04 and V05 calculates as follows as a difference signal Vd in the difference arithmetic circuit 25, respectively.
VS=V04+V05=2, M0, Vf1 (5)
Vd=V04-V05=2, M0, Vf1, and theta (6)
[0035] Synchronous detection is made by the synchronous detection circuits 26 and 27, respectively, using the sum signal VS as reference voltage, and the sum signal VS and the difference signals Vd, such as this, are outputted to low pass filters 28 and 29, respectively.
[0036] It is outputted to a comparator 30 and the gain of a control amplifier 23 is controlled by the control signal VC which is compared with a programmed voltage VR here and appears in the output, and the output signal VSD of a low pass filter 28 is controlled so that an output signal VSD finally becomes equal to a programmed voltage VR.
[0037] Making the output signal VSD equal to a programmed voltage VR will control M0 and Vf1 uniformly. If the output signal VdD of the low pass filter 29 corresponding to the difference signal Vd makes K1 the constant determined from an excitation wave VdD=K1, M0, Vf1, andtheta (7)
It becomes.
[0038] Here, since M0 and Vf1 are controlled to become fixed, (7) types make K2 a constant. VdD=K2andtheta (8)
A next door and an output signal VdD will be proportional to the displacement angle theta, and the effect of a driving signal Vf1 etc. will not receive them.
[0039] Although drawing 4 is the property Fig. showing relation with the output signal VdD over the displacement angle theta, the differential signals V04 and V05 shown here are as follows.
V04=M0(1+theta) Vf1 (9)
V05=M0(1-theta) Vf1 (10)
[0040] Drawing 5 shows the configuration of other displacement signal arithmetic circuits which changed the configuration of the displacement signal arithmetic circuit shown in drawing 3 . Although considered as the configuration which controls a sum signal uniformly and outputs a difference signal in the circuit shown in drawing 3 , it is made to do the division of a sum signal and a difference signal with the configuration shown in drawing 5 .
[0041] From the oscillator 14, alternating voltage Vf0 is outputted and the driving

signal Vf2 is impressed to the drive coil 13 through amplifier 31. the differential signal V05 generated to the both ends of the series circuit of differential signal V04' generated to the both ends of a series circuit with coils 17 and 20, and coils 18 and 19 -- ' -- respectively -- in the sum arithmetic circuit 24, the sum of differential signal V04' and V05' is outputted as sum signal VS', and the difference of differential signal V04' and V05' is outputted as difference signal Vd' in the difference arithmetic circuit 25, respectively.

[0042] It is outputted to the ratio arithmetic circuit 32, ratio Vd'/VS', such as this, calculates here, VS and Vd are replaced with a formula (5) to the outgoing end from (6) as output signal VdD' at VS' and Vd', and these sum signal VS' and difference signal Vd' are VdD'=theta. (11)

****

[0043] Thus, output signal VdD' becomes the function of the displacement angle theta, detects this synchronously by making sum signal VS' into a reference sign in the synchronous detection circuit 33, and can acquire the output signal corresponding to the variation rate of the direct current to the outgoing end through a low pass filter 34.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

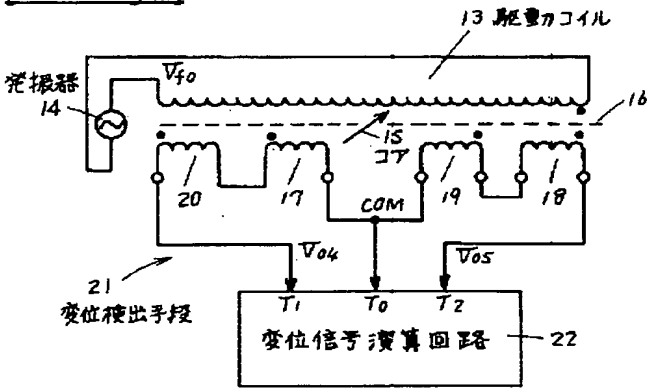
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the gestalt of 1 operation of this invention.
[Drawing 2] It is the block diagram showing the configuration of the conductor pattern of the coil shown in drawing 1 .
[Drawing 3] It is the block diagram showing the concrete configuration of the gestalt of operation shown in drawing 1 .
[Drawing 4] It is the property Fig. showing the relation of the differential signal over the displacement angle of the gestalt of operation shown in drawing 1 .
[Drawing 5] The gestalt of operation shown in drawing 1 is the block diagram showing other different concrete configurations.
[Drawing 6] It is the block diagram showing the configuration of the 1st conventional displacement inverter.
[Drawing 7] It is the block diagram showing the conventional configuration of the 2nd displacement inverter which improved the conductor pattern part.
[Drawing 8] It is the connection diagram showing the connection configuration of the conductor pattern shown in drawing 7 .
[Drawing 9] It is the property Fig. showing the property of the displacement inverter shown in drawing 7 .
[Drawing 10] It is the block diagram showing the concrete configuration using the conductor pattern shown in drawing 7 .
[Description of Notations]
1, 8, 16 Insulating substrate
2, 3, 17-20 Coil
4 15 Core
5 Shaft
6 Seven Electric conduction pattern
10 14 Oscillator
11 Synchronous Detection Circuit
12 Low Pass Filter
13 Drive Coil
21 Displacement Detection Means
22 Displacement Signal Arithmetic Circuit
24 Sum Arithmetic Circuit
25 Difference Arithmetic Circuit
30 Comparator

[Translation done.]

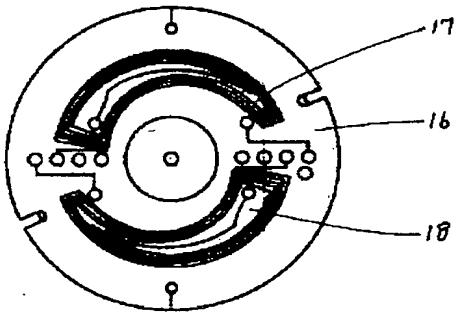
DRAWINGS

[Drawing 1]

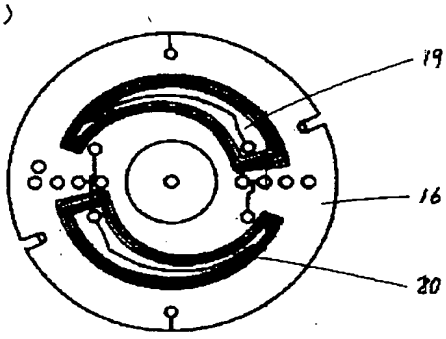


[Drawing 2]

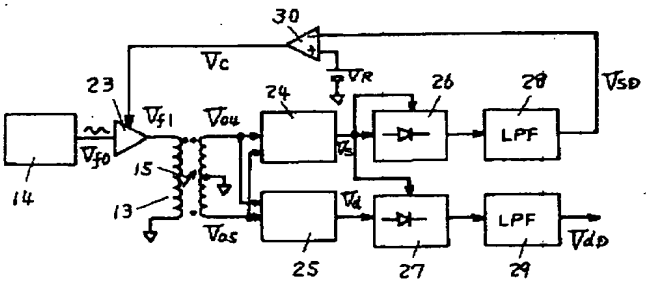
(A)



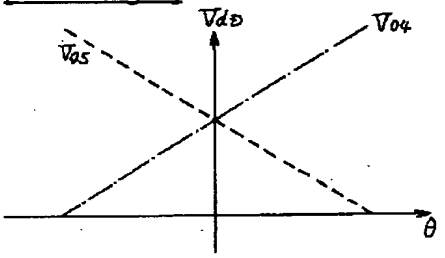
(B)



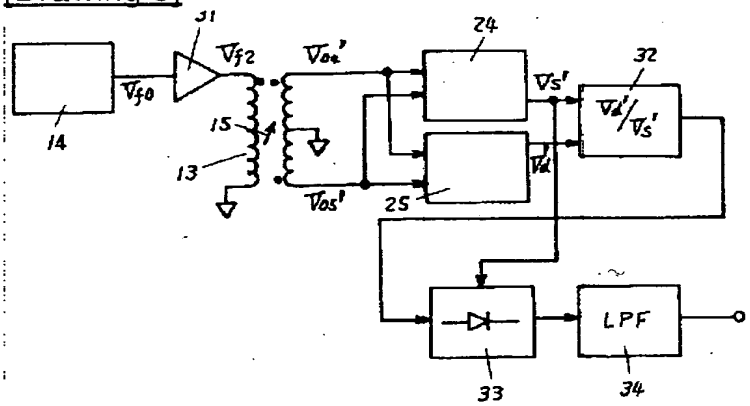
[Drawing 3]



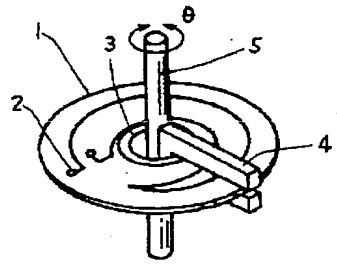
[Drawing 4]



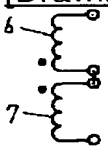
[Drawing 5]



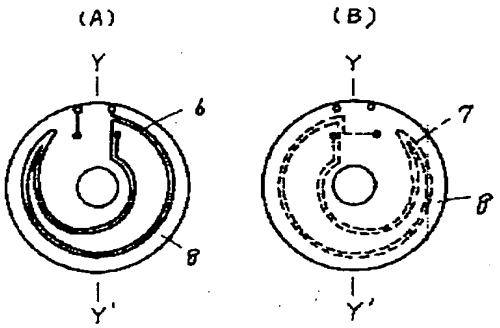
[Drawing 6]



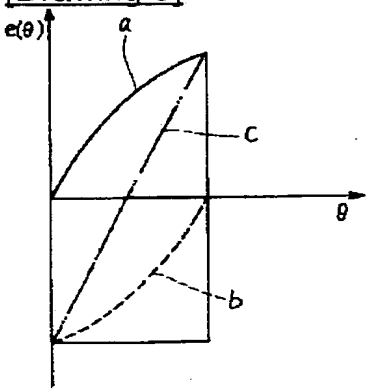
[Drawing 8]



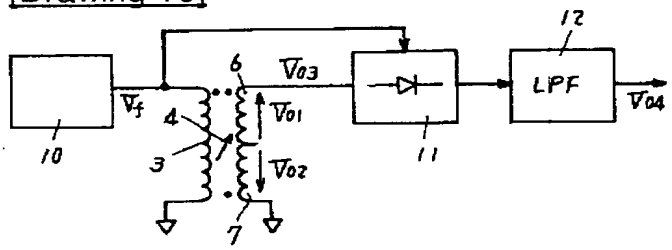
[Drawing 7]



[Drawing 9]



[Drawing 10]



[Translation done.]